Space Weather Technical Forecast

Issued on Saturday, 12 November 2022 at 00:49 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of further M-class flares (R1-R2/Minor to Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with two M class flares from AR3141, the largest of which was an M1.2 flare at 11/0714 UTC. There are three numbered regions on the visible disc. AR3141 remains the most significant and complex of the regions and is classified as a Eki/Beta-Gamma. AR3140 showed some development with emergence of rear penumbra and trailing spots, and is now classified as Dso/Beta. The remaining region, AR3145, is a weakening Axx/Alpha group and continues to fade.

No Earth-directed CMEs have been observed on available imagery. A CME was observed lifting off of the western limb around 11/0830 UTC, modelling and analysis of available imagery projects a clear miss with no Earth-directed component expected.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, saw an increase from slow-ambient to slightly elevated with wind speeds generally varying between 400/430 km/s. Density has shown a slight upward trend from average levels, fluctuating just above average. Total magnetic field strength (IMF) was initially weak, but increased through the period to Moderate, with levels around 11 nT. The north-south component, Bz, fluctuated between +12/-10 nT. Phi angle has been mostly negative (towards the Sun), becoming mainly positive (away from the Sun) at times 11/0800-1300 UTC. Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2 MeV) at GOES-16 has generally been at Background to Moderate levels. At the peak of the diurnal cycle, High levels were briefly reached, peaking at 1140 pfu at 11/1655 UTC. Electron fluence levels remain well below Active levels. Observed fluence at 12/0001 UTC was 1.98e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be generally Low, with a chance of further isolated M-Class flare activity. The most likely source of activity is from the largest and most complex region AR3141 Eki/Beta-Gamma.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently forecast.
Solar winds are currently at slightly elevated levels, and are expected to return to slow-ambient levels over the next 24 hours as HSS effects wane. On day 4 (15 November), a further weak coronal hole enhancement to solar winds is possible. Geomagnetic activity is expected to be mainly Quiet to Unsettled (Kp 0-3) with a slight chance of Active (Kp 4) intervals on day 1 (12

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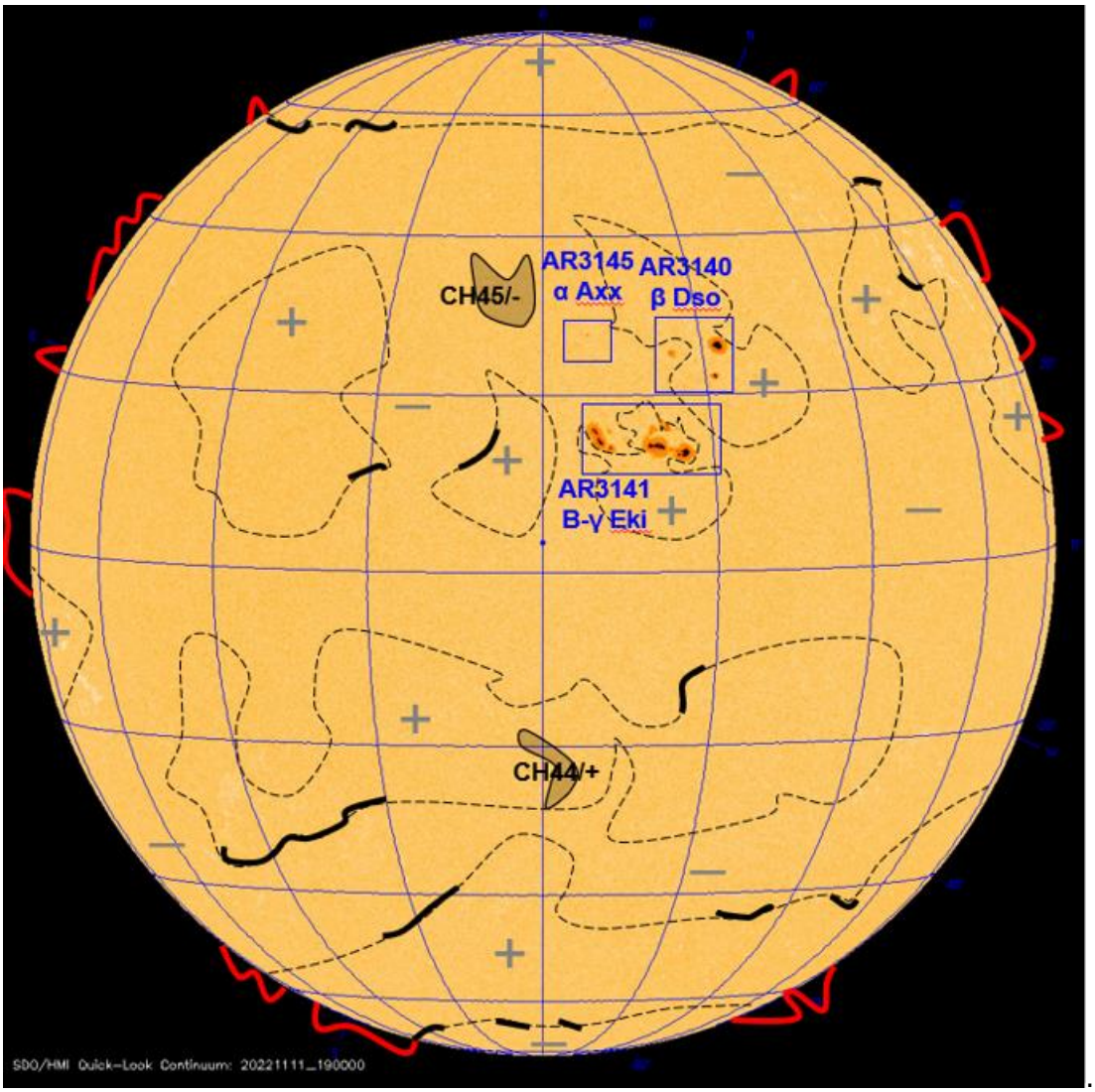
November) and day 4 (15 November).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) observed by GOES-16 is expected to remain at background levels. There may be a slight increase in the probability of solar radiation storms later in the period. Electron flux is forecast to be at background to moderate levels throughout the period, perhaps exceeding the high threshold during a diurnal peak on day 1 (12 November). Fluence values are expected to remain below Active throughout the period.

Figure 1. Solar Analysis Valid 11/1900UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs are currently forecast. A CME was observed lifting off of the western limb around 11/0830 UTC, modelling and analysis of available imagery projects a clear miss with no Earth-directed component expected.

Solar winds are currently at slightly elevated levels, likely a result of a weak coronal hole connection. Winds are expected to return to slow-ambient levels over the next 24 hours as HSS effects wane.

There are two small coronal holes on the visible disc, CH45 in the northern hemisphere and CH44 in the south. CH45 is expected to rotate into a geoeffective position around day 4 (15 November), at which point a further weak enhancement to solar winds is possible.

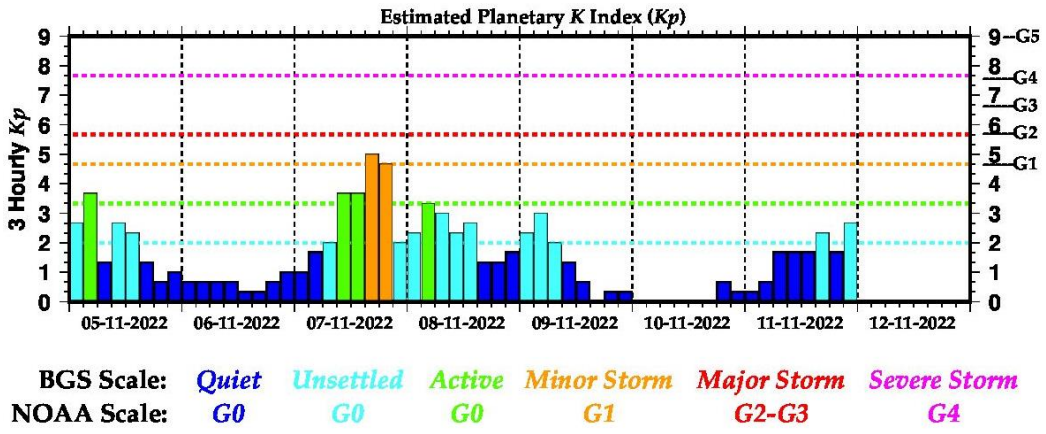
Geomagnetic activity is initially expected to be mainly Quiet to Unsettled with a slight chance of Active intervals on day 1 (12 November). Generally Quiet conditions then likely to prevail through days 2 and 3 (13 & 14 November), before possible weak coronal hole influence by day 4 (15 November), which brings a slight chance of Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil expected.

Figure 2: BGS 3-Hourly Kp index



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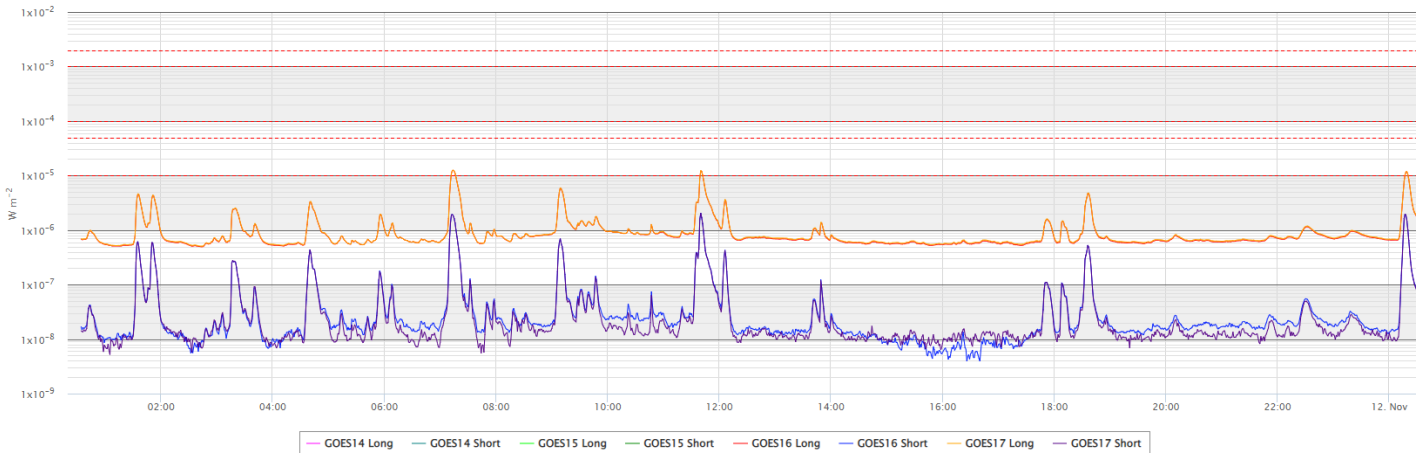
Radio Blackouts - X-Ray Flares:
Solar activity is likely to be generally Low, with a chance of further isolated M-Class flares. The most likely source of activity is from the largest and most complex region AR3141 Eki/Beta-Gamma. The remaining regions on the visible disc are far less likely to produce significant flares.

One returning active region will rotate onto the visible disc during day 1 (12 November). Two further returning active regions are due to potentially rotate across the limb towards the end of the period. These three regions may contribute to the overall flare risk.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES16 X-Ray Flares - Note a further M1.1 flare at 12/0018UTC



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Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at Background levels and is forecast to remain at this level throughout the period.

As AR3141 transits into a more geoeffective position there is a slight increase in the probability of proton storms, however, this is on the assumption that the spot remains complex in configuration.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):
Electron flux (greater than 2MeV) is currently at Background to Moderate levels. Electron flux is forecast to remain at predominantly Background to Moderate levels through the period, with the most probable trend a steady decrease. On day 1 (12 November), there is a slight chance of perhaps briefly approaching or exceeding the High threshold (1e3 pfu) during a diurnal peak.

Electron fluence values are below the Active (1e8 integrated pfu) threshold and are expected to remain so throughout the period, with a largely downward trend most probable. The MOSWOC REF Model is currently supports electron fluence values remaining below the 1e8 Active threshold, however, model confidence in absolute values beyond day 2 (13 November) is low.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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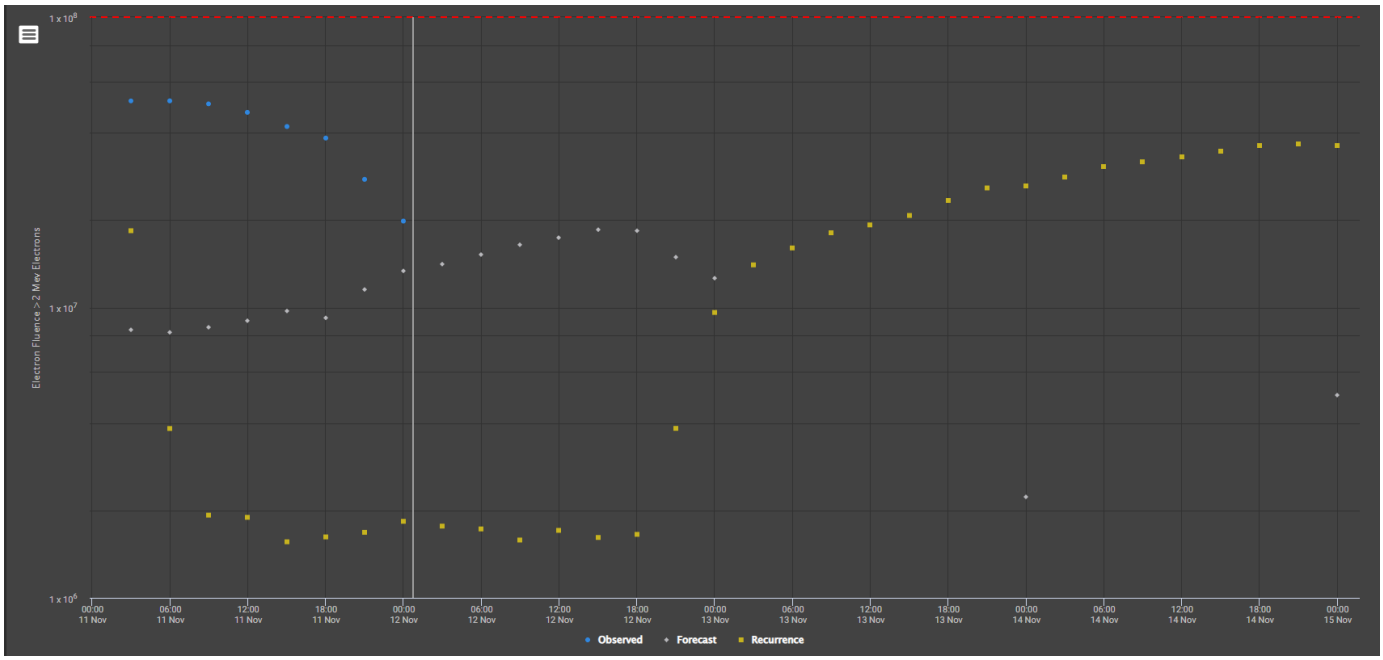
Figure 4: MOSWOC REF Model - Showing observed integrated fluence values above the forecast levels



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